

THE CLAIMS

What is claimed is:

1. A method for recycling a substrate that has a residue on its surface and a detachment profile resulting from an ion implantation process comprising:
 - removing the residue from the substrate to a level substantially equivalent to that of the detachment profile to obtain a substantially uniform planar surface on the substrate; and
 - polishing the entire surface of the substrate to eliminate defects and to prepare the surface in condition for molecular bonding to another substrate.
2. The method according to claim 1 wherein the residue is removed using local polishing.
3. The method according to claim 2 which further comprises applying mechanical pressure at an angle relative to the surface of the substrate.
4. The method according to claim 2 which further comprises controlling removal of the residue with a mechanical profilometer.
5. The method according to claim 1 wherein the residue is removed using a chemical attack.
6. The method according to claim 1 which further comprises covering a region on the surface with a protective layer before removing the residue.
7. The method according to claim 6 wherein the protective layer is formed by photolithography.
8. The method according to claim 6 wherein the protective layer is an etch resistant material and is applied prior to the chemical removal of the residue.
9. The method according to claim 1 which further comprises using a local ion attack to remove the residue.

10. The method according to claim 9 which further comprising directing an ion beam approximately perpendicular to the surface of the substrate to remove the residue.
11. The method according to claim 9 wherein the local ion attack is provided by an Argon ion beam.
12. The method according to claim 1 wherein the residue is severed from the substrate to obtain a substantially uniform planar surface on the substrate.
13. The method according to claim 12 which further comprises using a laser beam to sever the residue.
14. The method according to claim 13 wherein the laser beam is focused on at least the interface.
15. The method according to claim 13 wherein the laser beam is aligned parallel to the surface of the substrate.
16. The method according to claim 15 which further comprises focusing the laser beam onto the residue with a screen having a slit.
17. The method according to claim 12 wherein the residue is severed by directing at least one of a jet stream of water, a jet stream of air, and a jet stream of fluid at it.
18. The method according to claim 17 wherein the jet stream is directed against the residue at an acute angle to the surface.
19. The method according to claim 17 wherein the jet stream impinges at least on the interface.
20. The method according to claim 12 which further comprises rotating the substrate to remove or sever the residue.

21. The method according to claim 12 which further comprises applying a shock wave on a back side of the substrate to sever the residue.

22. The method according to claim 12 which further comprises bombarding the residue with at least one of ions and ion clusters to sever the residue.

23. The method according to claim 22 which further comprises bombarding the residue at the interface with the ions or ion clusters.

24. The method according to claim 1 wherein the residue is removed or severed in a piecewise manner.

25. The method according to claim 1 further comprising planarizing the entire surface of the substrate after removal of the residue so that the surface is in a condition for bonding to another semiconductor substrate.

26. The method according to claim 25 which further comprises thinning the surface by about 0.1 to 0.3 μm during planarizing.

27. The method according to claim 1 wherein the substrate is planarized without a heat treatment.